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TECHNICAL MANUAL

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GOVERNMENT DOCUMENTS

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL
FOR

AMPLIFIER, RADIO FREQUENCY AM-3979/FRC-93
(COLLINS MODEL 30L-1)
(NSN 5820-00-082-4081)

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92-34-2

WARNING

Be careful when working on the 1800-volt dc output terminals of the high voltage power supply, and the 115-volt or 230-volt ac line terminals.

DON'T TAKE CHANCES!

WARNING

Operator and maintenance personnel should be familiar with the requirements of TB SIG 291 before attempting installation, operation, or repair of the equipment covered in this manual. Failure to follow the requirements of TB SIG 291 could result in injury or death.

Information in this manual has been furnished by the Collins Radio Company and shall not be either released outside the government, or used, duplicated, or disclosed in whole or in part for manufacture or procurement, without the written permission of the Collins Radio Company.

TM 11-5820-544-34-1

TECHNICAL MANUAL

No. 11-5820-544-34-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 30 August 1976

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

AMPLIFIER, RADIO FREQUENCY AM-3979/FRC-93 (COLLINS MODEL 30L-1) (NSN 5820-00-082-4081)

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and content specified in AR 310-3. This technical manual does, however, contain available information that is essential to direct and general support maintenance of the equipment.

REPORTING OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028-2 (Test) located in the back of the manual. Simply tear out the self-addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

If there are no blank DA Form 2028-2 (Test) in the back of your manual, use the standard DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward to the Commander, ATTN: DRSEL-MA-Q, Fort Monmouth, New Jersey 07703.

A reply will be furnished direct to you.

		Paragraph	Page
CHAPTER	1. INTRODUCTION		
SECTION	I. General		
	Scope	1-1	1-1
	Indexes of publications	1-2	1-1
	Administrative storage	1-3	1-1
	Destruction of Army materiel	1-4	1-1
	II. Description and data		
	Description	1-5	1-1
	Tabulated data	1-6	1-1
CHAPTER	2. CIRCUIT FUNCTIONING		
	General	2-1	2-1
	Input circuits	2-2	2-1
	Output circuits	2-3	2-1
	Power supply circuits	2-4	2-2
	Safety interlock circuits	2-5	2-2
	Power control circuits	2-6	2-2
	ALC circuits	2-7	2-2
	Metering circuits	2-8	2-3
CHAPTER	3. DIRECT AND GENERAL SUPPORT MAINTENANCE		
SECTION	I. Troubleshooting procedures		
	General instructions	3-1	3-1
	Organization of troubleshooting procedure	3-2	3-1
	Tools, test equipment, and materials required	3-3	3-1

*This manual supersedes so much of TM 11-5820-532-15, 28 January 1965, as pertains to direct support and general support maintenance instructions.

	Paragraph	Page
II. Maintenance instructions		
General.....	3-4	3-2
Removal of cabinet and covers	3-5	3-2
Blower lubrication.....	3-6	3-2
Alignment of rf input circuits	3-7	3-2
Meter lamp replacement.....	3-8	3-3
Tube replacement	3-9	3-3
Multimeter adjustment.....	3-10	3-4
ALC threshold adjustment	3-11	3-5
APPENDIX A. REFERENCES		A-1

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual covers direct support and general support maintenance for Amplifier, Radio Frequency AM-3979/FRC-93 (Collins Model 30L-1), hereafter referred to as the 30L-1. This manual includes direct and general support categories for calibration and adjustment of the equipment. This manual also lists tools and test equipment for direct and general support maintenance. The complete manual includes TM 11-5820-554-12.

1-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to this equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to this equipment.

NOTE

For applicable forms and records, refer to TM 11-5820-554-12.

1-3. Administrative Storage

Administrative storage of electronic equipment is covered in detail in TM 740-90-1.

1-4. Destruction of Army Materiel

Destruction of Army materiel to prevent enemy use shall be as prescribed in TM 750-244-2.

Section II. DESCRIPTION AND DATA

1-5. Description

A general description of the AM-3979/FRC-93 and its purpose and use are contained in TM 11-5820-544-12.

1-6. Tabulated Data

A list of tabulated data of the AM-3979/FRC-93 is contained in TM 11-5820-544-12.

CHAPTER 2

CIRCUIT FUNCTIONING

2-1. General

The 30L-1 is a portable RF linear power amplifier, and includes its own plate power and bias supplies. It is capable of 1,000 watt peak effective power (pep) input power in single sideband (ssb) or 1,000 watts direct current (d.c.) input power in continuous wave (cw) operation with any exciter, such as the KWM-2/2A capable of 70 watts pep nominal output. It covers the amateur bands between 3.5 and 29.7 Mega Hertz (MHz). In addition, the amplifier may be operated outside the amateur band over certain ranges of frequencies. These ranges are specified in table 3-2. The power amplifier stage uses four 811A triodes connected in parallel with cathode drive.

2-2. Input Circuits

(fig. 2-1 and FO-2)

Broadband pi-network circuits couple the exciting signal into the cathode circuits of the power amplifier tubes. The tuned input circuits provide increased efficiency, reduced distortion, and a better impedance match for the exciter than normally would be obtained with an untuned input. Tuning adjustments are not required except for operation outside the amateur bands.

2-3. Output Circuits

(fig. FO-2)

The plate circuit of the power amplifier is tuned by a pi-network consisting of C32, L9, L10, and

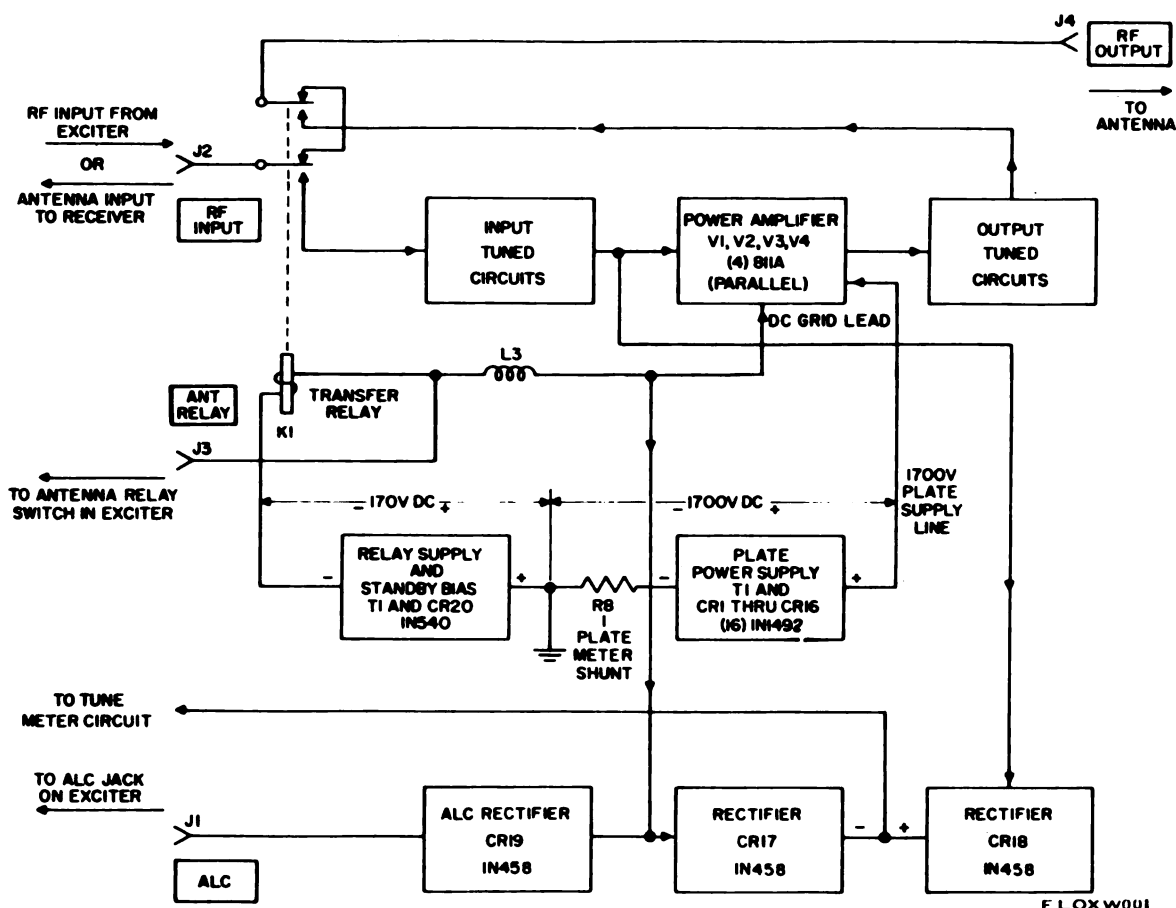


Figure 2-1. 30L-1, block diagram.

C33. Capacitor C32 resonates the tank circuit at the frequency in use. It is adjusted by the TUNING control on the front panel. The four-gang capacitor, C33, is adjusted by the LOADING control to match the pi-network circuit to the impedance presented by the antenna and feed system in use. Output from the plate tank circuit is connected through the contacts of ANTENNA relay K1, to the antenna when the control circuit are energized.

2-4. Power Supply Circuits

(fig. 2-2 and FO-2)

Two dc power supplies and one ac filament supply are included in the 30L-1. The amplifier may be connected to a 115-volt single-phase or to a 230-volt, 3-wire, single-phase source. Power transformer T1 has two primary windings. These windings are connected in parallel for 115-volt operation, and in series for 230-volt operation. The 0.3-volt secondary winding provides filament power for the 811A tubes through RF choke L8. It also powers the pilot lamp in the meter. Another secondary winding applies voltage through surge resistor R9 to semiconductor rectifier CR20. This is a half-wave circuit connected to furnish blocking bias to the amplifier tubes under receive conditions and operating bias when transmitting. It also furnishes power for ANTENNA relay K1. Voltage from the third secondary winding is applied to semiconductor rectifier strings connected in a full-wave rectifier voltage doubler configuration. These strings consist of CR1 through CR8, C44 through C51 in one string, and CR9 through CR16, C52 through C59 in the other. The parallel capacitors equalize the reverse voltages impressed across the diode junctions and protect against damage by transients. This supply pro-

vides approximately 1600 volts dc under load for the amplifier tube plates, and approximately 1800 volts unloaded.

2-5. Safety Interlock Circuits

(fig. FO-2)

WARNING

Do not block interlock switches. Contact with voltages in this equipment can be fatal. Disconnect the ac power plug before removing any of the covers.

The RF and power supply compartment covers operate safety interlock switches. Switches S5 and S7 are located in the power supply compartment and switch S6 is located in the RF compartment. Cover removal closes these switches and shorts the high voltage to ground. This prevents accidental contact with high-voltage dc which is present in either compartment.

2-6. Power Control Circuits

(fig. 2-2)

The front-panel ON-OFF switch breaks one side of the ac line in the OFF position. When operated to the ON position, ac power is applied to the power transformer primaries and tube cooling fan B1. Overload protection is provided by 8-ampere fuses F1 and F2. These are used for both 115-volt ac and 230-volt ac operations.

2-7. ALC Circuits

(fig. FO-2)

Automatic load control (ALC) is a compressor circuit operating at radiofrequencies. In the 30L-1, the grid-to-plate capacitances of the

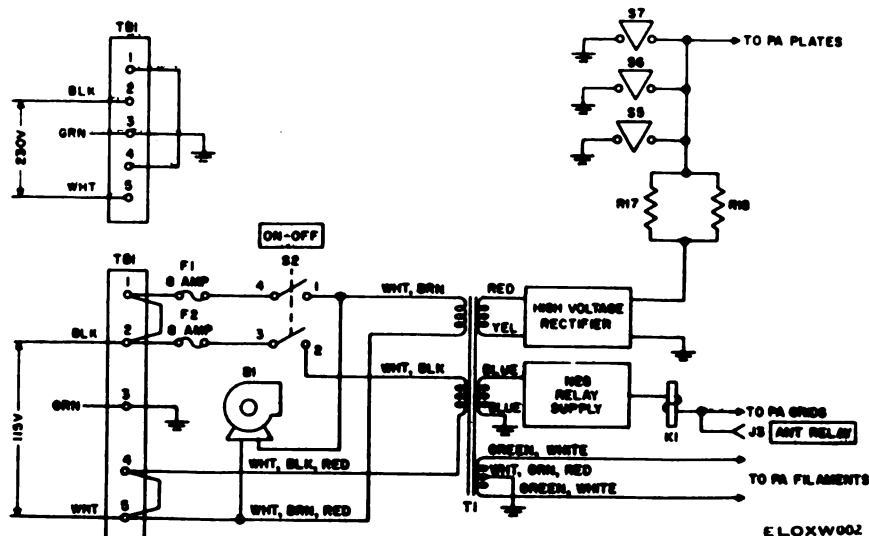


Figure 2-2. Control and interlock circuits.

amplifier tubes in conjunction with capacitors C22, C23, C24, and C25 form capacitive voltage dividers. Under modulation, an rf voltage is developed across these dividers and L3. It is coupled to ALC rectifier CR19 through capacitor C72. The rf voltage is rectified and filtered to produce a negative dc control voltage which is proportional to the modulation level. (The load resistor for CR19 must be provided by the exciter ALC circuits.) This voltage is applied by the control grid of a low-level rf amplifier tube or tubes in the exciter. The time constants of these circuits have a fast attack, slow-release characteristic. The ALC threshold is controlled by the amount of reverse bias on CR19. This voltage is developed across R7 in the plate supply bleeder network, and varied by potentiometer R16. It is adjusted at the factory for optimum operation in conjunction with the internal ALC circuits of exciters such as the KWM-2/2A. Normally it will not need readjustment. This system allows a high average level of modulation and optimum

power output from the amplifier, within the rated limits of distortion.

2-8. Metering Circuits

(fig. FO-2)

One section of METER switch S3 selects the output voltage from a tuning and loading bridge circuit. This circuit consists of the power amplifier tubes, CR17, CR18, and the associated load resistors and filter networks. The bridge is balanced when the plate circuit TUNING and LOADING controls are adjusted to present the proper load impedance to the power amplifier plates. The meter will then read zero. The second section of the meter switch connects the meter to the plate supply through a 4-megohm multiplier resistor to indicate the dc voltage output. It is read on the DC KILOVOLT scale. The third section of the meter switch connects the meter, through R10, across shunt R8. This indicates power amplifier plate current. It is read on the D.C. AMPS scale.

CHAPTER 3

DIRECT AND GENERAL SUPPORT MAINTENANCE

Section I. TROUBLESHOOTING PROCEDURES

3-1. General Instructions

a. Troubleshooting at direct and general support category includes all techniques outlined for organizational maintenance and special techniques required to isolate a defective part. The direct support maintenance procedures are not complete in themselves, but supplement the procedures described in operator and organizational maintenance (TM 11-5820-554-12). The systematic troubleshooting procedure, which begins with operational checks performed at an organizational category, must be completed by further localizing techniques.

b. Some troubleshooting procedures may be performed while the amplifier is operating as part of a system or, if necessary, after it has been removed from service. When trouble occurs, certain observations and measurements can be made which will help in determining whether the local equipment is at fault or if trouble exists elsewhere in the system.

3-2. Organization of Troubleshooting Procedure

a. *General.* The first step in servicing a defective equipment is to sectionalize the fault to a major component. The second step is to localize the fault to a defective stage. The third step is to isolate the fault by tracing it to the defective

part. Some faults, such as burned-out resistors and leaking capacitors, can often be isolated by sight or smell. The majority of faults, however, must be isolated by checking voltages and resistances and observing waveforms.

b. *Sectionalization Check.* After the trouble has been isolated to the amplifier by an organizational check, perform the operational procedures listed in TM 11-5820-554-12.

c. *Localization and Isolation.* Because dangerously high rf voltage is present throughout the circuitry, localization and isolation is best accomplished by resistance and continuity checks of the equipment. Refer to figure FO-1 for resistor, capacitor, and inductor color codes, and to figure FO-2 for the schematic diagram.

d. *Intermittent Troubles.* In all tests, the possibility of intermittent trouble should not be overlooked. If present, this type of trouble may be made to appear by tapping or jarring the unit under test.

3-3. Tools, Test Equipment, and Materials Required

Table 3-1 contains a list of the tools and test equipment required for direct support maintenance of the 30L-1. In addition, the associated technical manual is listed, where applicable. No special materials are required for direct support maintenance.

Table 3-1. Tools and Test Equipment Required

Equipment item	National stock number	Qty	Applicable literature
Multimeter AN/USM-223	6625-00-999-7465	1	TM 11-6625-654-14
Multimeter ME-26(*)/U	6625-00-913-9781	1	TM 11-6625-200-15
Test Set, Electron Tube TV-7D/U	6625-00-820-0064	1	TM 11-6625-274-12
Tool Kit, Electronic Equipment TK-100/G	5180-00-605-0079	1	
Tool Kit, Electronic Equipment TK-101/G	5180-00-064-5178	1	
Tool Kit, Electronic Equipment TK-105/G	5180-00-610-8177	1	
Dummy Load DA-75	6625-00-177-1639	1	
Wattmeter AN/URM-120	6625-00-813-8430	1	TM 11-6625-446-15
Oscilloscope AN/USM-281(*)	6625-00-177-1629	1	TM 11-6625-1703-15
Test Set, Radio AN/URM-134A	6625-00-474-0359	1	NAVSHIPS 94.791
Transceiver RT-718/FRC-93	5820-00-082-4080	1	TM 11-5820-554-12
Power Supply PP-4151/FRC-93	5820-00-985-8099	1	TM 11-5820-554-12
Control, Radio Set C-6118/FRC-93	5820-00-082-4082	1	TM 11-5820-554-12

Section II. MAINTENANCE INSTRUCTIONS

3-4. General

Adjustment of the 30L-1 rf input circuits requires Control, Radio Set C-6118/FRC-93 or C-7517/FRC-93 and Dummy Load DA-75. A fuse consisting of a number 28 wire in the center-tap ground return of the filament winding of T1 is included to protect the pa tubes from excessive plate current. The fuse is connected between the two outer lugs of a terminal strip located near R11 in the power supply compartment (fig. 3-2). Under some conditions, the amplifier may appear to function normally even though this fuse has blown; however, this causes hum to appear on the output signal. Check for shorts in the filament circuit.

3-5. Removal of Cabinet and Covers

a. Lift the cabinet lid and remove the two Phillips-head screws located at the top-front edge of the cabinet. Remove the four feet and the Phillips-head screw located midway between the rear feet. Push the amplifier forward from the rear until the front panel projects from the cabinet about one-half inch. Grasping the front panel at the edges, carefully slide the amplifier out of the cabinet, making sure the ac power cord clears.

b. To remove the rf compartment upper cover, loosen the 10 screws about three turns, slide the cover toward the front panel, and lift off.

c. To remove the power supply compartment upper cover, remove screws located about the edges of the cover.

d. To remove the bottom cover, remove two round Phillips-head screws from each end of the

cover and three flathead screws near the middle of the cover, and lift off.

3-6. Blower Lubrication

Every 1,000 hours of operation (or 6 months, whichever comes first), lubricate the blower motor bearings with three or four drops of Lubricating Oil, General Purpose NSN 9150-00-273-2389. Do not overlubricate.

3-7. Alignment of Rf Input Circuits

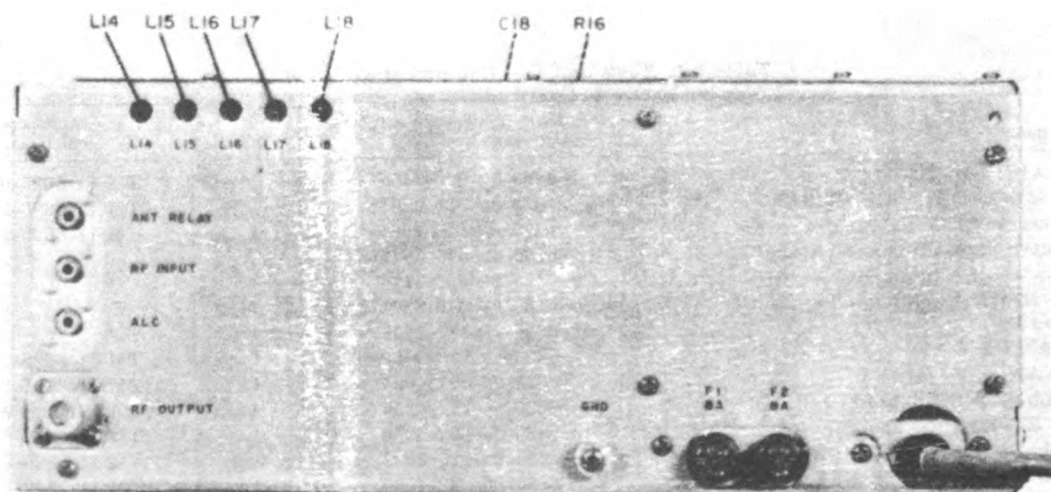
a. Remove the amplifier from its cabinet as outlined in paragraph 3-5. Do not remove any of the covers. To align the amateur band coverage, proceed as follows:

(1) Connect a directional wattmeter (C-6118/FRC-93 control wattmeter, or equivalent) between the KWM-2/2A output and the RF INPUT jack J2 on the 30L-1. Connect Dummy Load DA-75 to RF OUTPUT jack J4.

(2) Tune and load the 30L-1 at 28.5 MHz. Place the 30L-1 METER switch in the TUNE position.

(3) Apply 30 watts of forward drive power to the 30L-1 (as monitored on the wattmeter installed in a(1) above). This can be done by placing the KWM-2/2A EMISSION switch to the LOCK KEY position and adjusting the MIC GAIN control to the desired level.

(4) Tune L14 until minimum reflected power is indicated on the wattmeter, readjust the KWM-2/2A as necessary to maintain 30 watts of forward drive power. Continue adjusting L14 for minimum reflected power (the reflected power



ELOXW003

Figure 3-1. Location of adjustments.

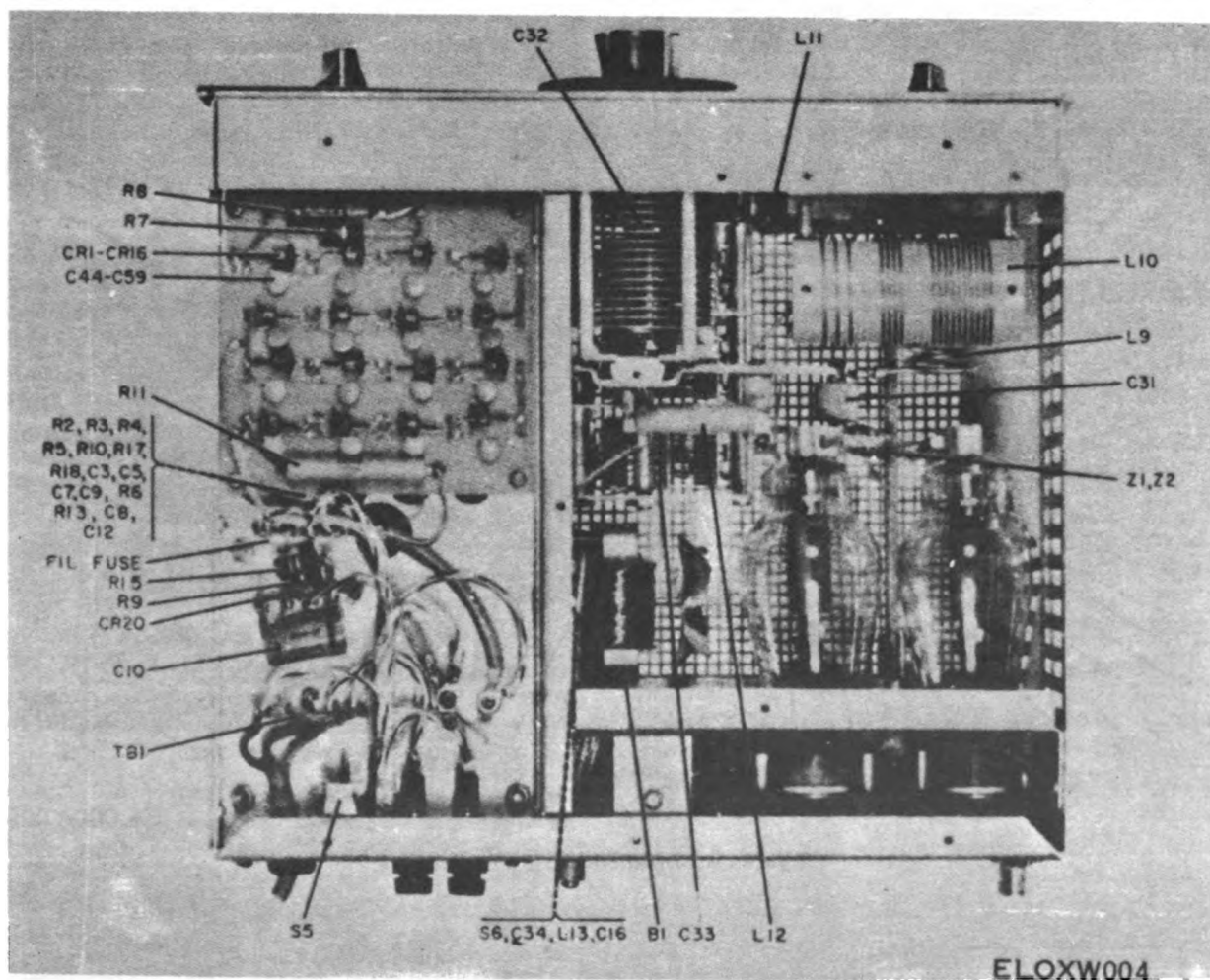


Figure 3-2. Rf and power supply compartments, parts location.

level should not exceed 3.3 watts). Refer to figure 3-1 for location of L14.

b. Repeat the above procedure at the middle frequency of each band, adjusting L15, L16, L17, and L18 when aligning the 21.0, 14.0, 7.0, and 3.5-MHz bands respectively.

c. For general coverage, use the same procedure as above, except set the KWM-2/2A to a frequency which is in the middle of the desired band. Useful bandwidth at the new alignment frequencies is approximately the same as that for amateur bands. Do not attempt alignment to place the new operating bands outside the range listed in table 3-2 for the BAND switch positions indicated. Also, do not attempt amateur band operation on a BAND switch position for which the tuned circuits have been realigned for out-of-band operation.

3-8. Meter Lamp Replacement

To replace the meter lamp, remove the bracket to which the socket is fastened. It is held by a small machine screw located at the rear of the

Table 3-2. Frequency Coverage Allowable by Alignment

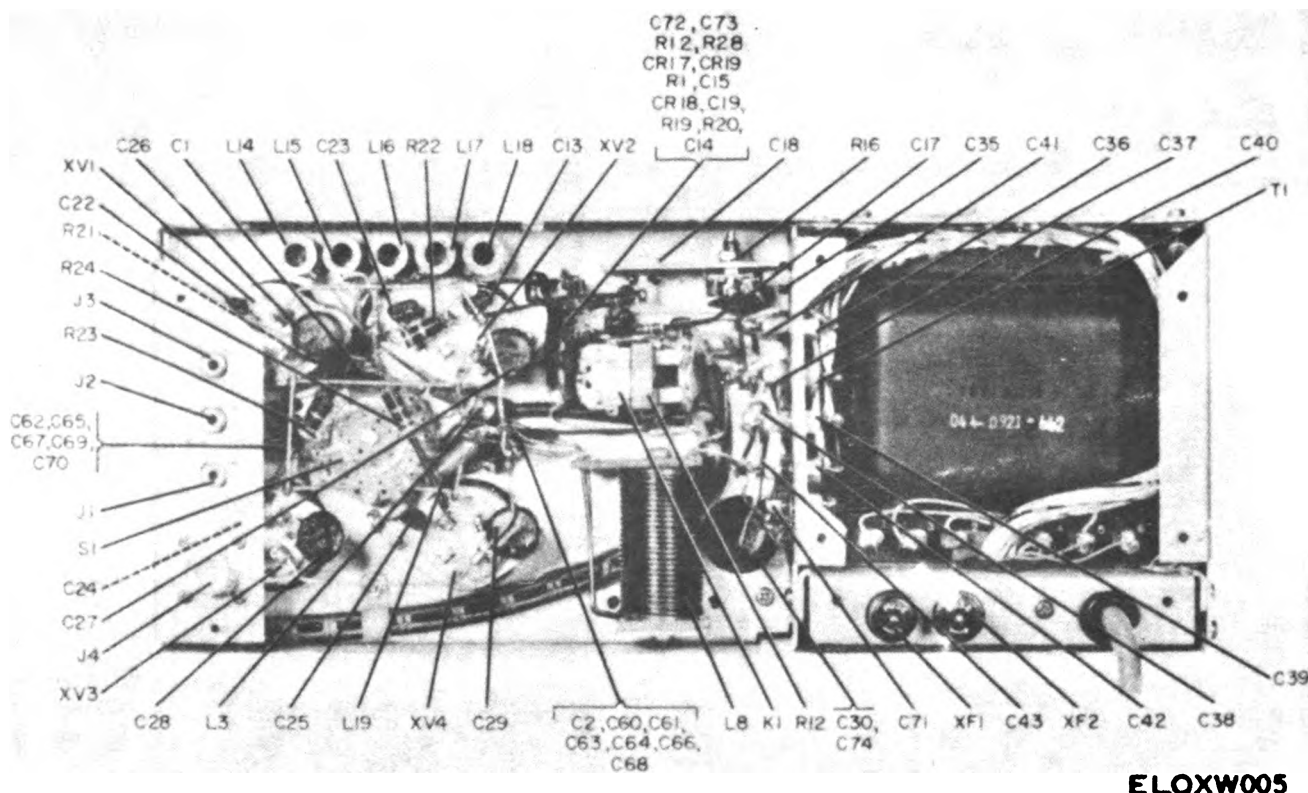
BAND switch settings	Lower Limit (MHz)	Upper limit (MHz)
3.5	3.4	5.0
7.0	6.5	9.5
14	9.5	16.0
21	16.0	22.0
28	22.0	30.0

meter. Replace the lamp with a type 47, or equivalent.

3-9. Tube Replace

WARNING

Do not block interlock switches. Dangerous voltages are present in this equipment. The high voltage is interlocked with the amplifier covers. Make no attempt to put the amplifier into service until the procedure outlined below has been completed.



ELOXW005

Figure 3-3. Input circuitry, parts location.

The tubes may be replaced without removing the amplifier cabinet by removing the RF compartment top cover and installing the tubes from the top. The following is an alternate method which provides better access to the tube sockets. Remove the cabinet, RF compartment top cover, and bottom cover as outlined in paragraph 3-5. Disconnect the plate connectors and remove the old tubes. Install the upper pair of replacements from the top of the amplifier. Install the lower pair from the bottom. The locating pin on the base of each of the tubes should point away from the power supply compartment. Attach the plate leads, making sure they clear other components. Replace the covers and cabinet.

CAUTION

Adjustments to the Multimeter and ALC circuits should not be made unless the need has been clearly determined. If trouble exists, check the pa tubes and the KWM-2/2A first. Improper adjustments can result in damage to the amplifier and a distorted output signal. Do not attempt to make adjustments without proper test equipment.

3-10. Multimeter Adjustment

- Make normal connections between the KWM-2/2A and the 30L-1.
- Connect Dummy Load DA-75 to the rf output jack J4.
- Connect the vertical input of a wideband oscilloscope across the dummy load.
- Connect a two-tone audio input signal (1,200 and 1,900 Hz at approximately 15 mv) to the KWM-2/2A microphone input jack.
- Tune and load the 30L-1 at 14.3 MHz.
- Place the 30L-1 METER switch to TUNE, and decrease the drive to zero, this is done by turning the KWM-2/2A MIC GAIN control fully counterclockwise.
- Set up the KWM-2/2A for upper sideband operating by placing the FUNCTION switch to USB.
- Monitor the output waveform on the oscilloscope. Increase the KWM-2/2A output by turning the MIC GAIN control clockwise until the 30L-1 output ceases to increase, or the peaks on the oscilloscope indication begin to flatten.
- Make sure that the KWM-2/2A and the 30L-1 are tuned properly by making fine ad-

justments to both units until maximum output, as monitored on the oscilloscope, is obtained without peak flattening. The output voltage across the dummy load should not be less than 450 volts peak-to-peak (160 volts rms).

j. Adjust the KWM-2/2A to give approximately 300 ma of 30L-1 plate current at dip (this is done by setting the FUNCTION switch to TUNE and turning the MIC GAIN control to approximately 3/4 fully clockwise). An access hole is provided to adjust C18 through the top cover of the 30L-1 with the cabinet lid raised. Refer to figure 3-1 or 3-2 for location of C18. Adjust C18 with an alignment tool to produce a reading of zero on the 30L-1 multimeter.

3-11. ALC Threshold Adjustment

a. Perform the procedures in paragraph 3-10a, b, d, and e.

b. Disconnect the ALC cable between the KWM-2/2A and the 30L-1.

c. Using USB or LSB emission, increase the drive until the indicated ALC is about 4 db (S-4) on the KWM-2/2A meter.

d. Reconnect the ALC cable and adjust R16 with an insulated tuning tool for a 3-db (one S-unit) increase in ALC.

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.	TM 11-6625-274-12	ME-26A/U, ME-26B/U, ME-26C/U, and ME-26D/U.
DA Pam 310-7	US Army Equipment Index of Modification Work Orders.		Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies, and Equipment Used by the Army.	TM 11-6625-446-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Wattmeter AN/URM-120.
TB SIG 222 TB SIG 291	Solder and soldering. Safety Measures to be Observed When Installing and Using Whip Antennas, Field Type Masts, Towers, Antennas, and Metal Poles That are Used with Communication, Radar, and Direction Finder Equipment.	TM 11-6625-654-14	Operator's, Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tool Lists (Including Depot Maintenance Repair Parts and Special Tool Lists) for Multimeter AN/USM-223.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.	TM 11-6625-1703-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Oscilloscope AN/USM-281A.
TM 11-5820-554-12	Operator's and Organizational Maintenance Manual, for Radio set AN/FRC-93 (NSN 5820-00-082-4276)	TM 38-750	The Army Maintenance Management Systems (TAMMS).
		TM 740-90-1	Administrative Storage of Equipment.
TM 11-6625-200-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Multimeters	TM 750-244-2	Procedures for Destruction of Electronic Materiel to Prevent Enemy Use (Electronics Command).

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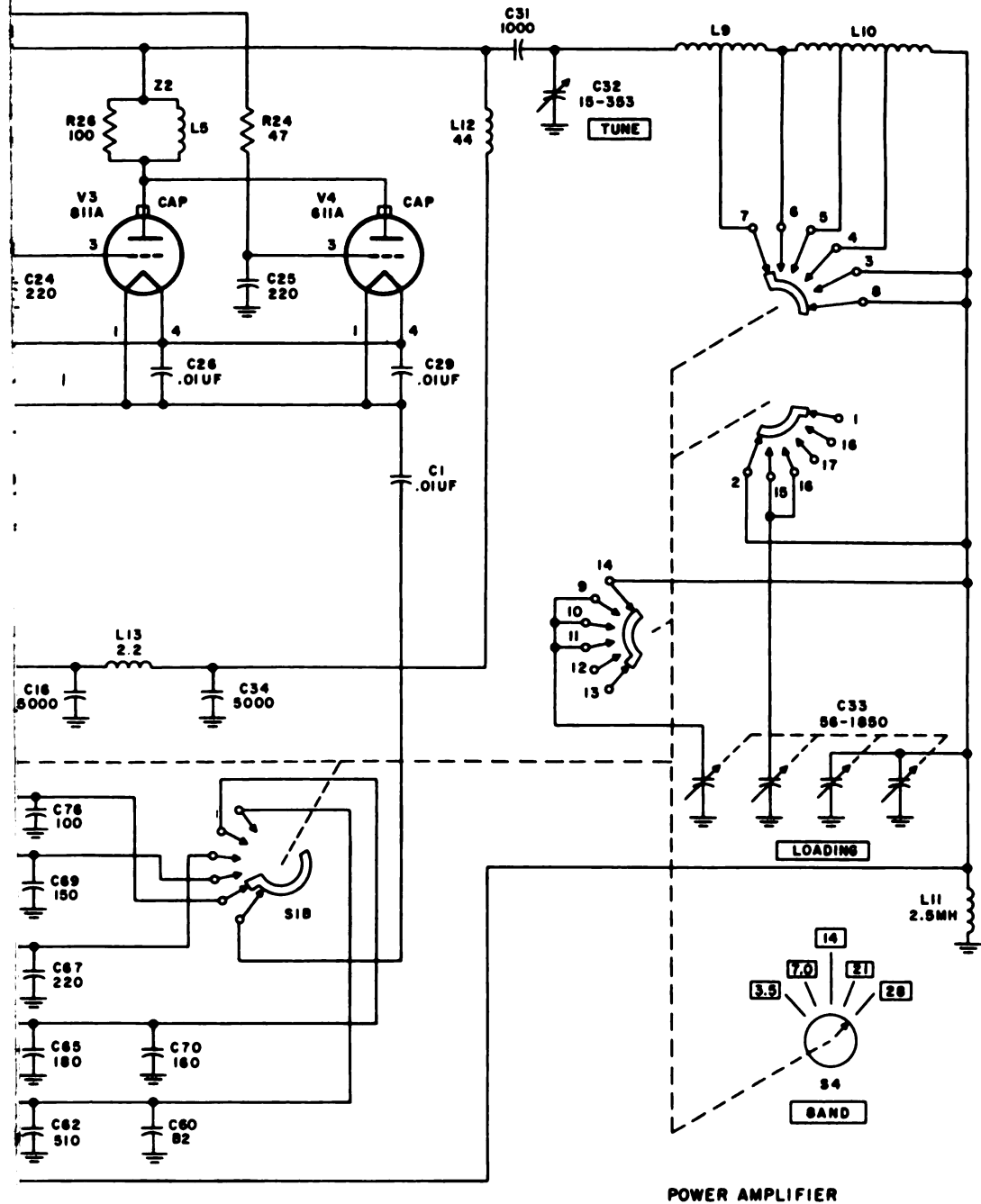
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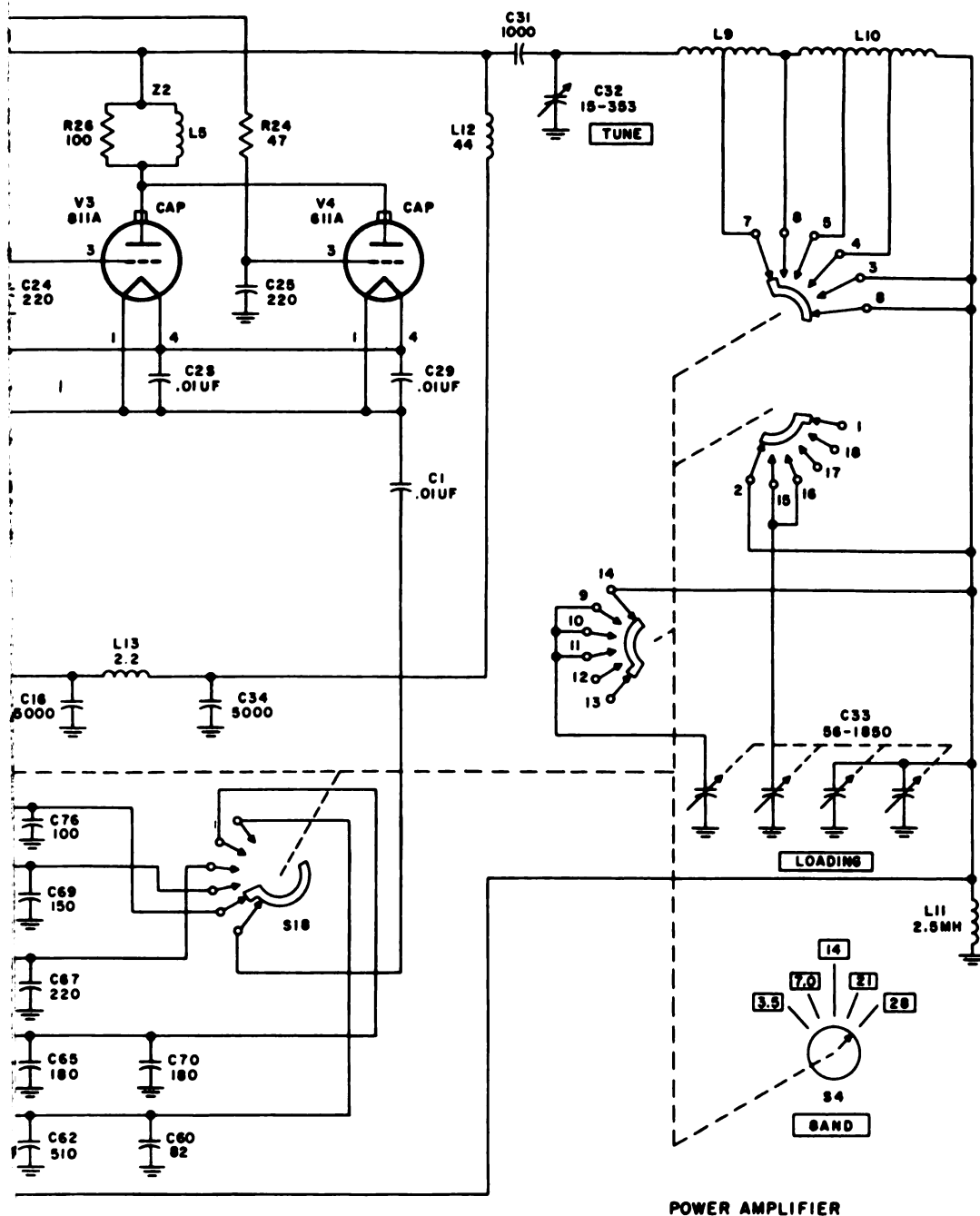
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POWER AMPLIFIER

ELOXW006



ELOXW006

TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB.

COLOR	MIL ID	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER ¹	CAPACITANCE TOLERANCE				CHARACTERISTIC ²			DC WORKING VOLTAGE	OPERATING TEMP RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CB			
BLACK	CM, CY, CB	0	0	1			±20%	±20%		A			-55° TO +70°C	10-55 Hz
BROWN		1	1	10					B	E	B			
RED		2	2	100	±2%		±2%	±2%	C				-55° TO +85°C	
ORANGE		3	3	1,000		±30%			D		D	300		
YELLOW		4	4	10,000					E				-55° TO +125°C	10-2,000 Hz
GREEN		5	5		±5%				F			500		
BLUE		6	6										-55° TO +150°C	
PURPLE (VIOLET)		7	7											
GRAY		8	8											
WHITE		9	9											
GOLD				0.1			±5%	±5%						
SILVER	CN			0.01	±10%	±10%	±10%	±10%						

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC.

COLOR	TEMPERATURE COEFFICIENT ⁴	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER ¹	CAPACITANCE TOLERANCE		MIL ID
					CAPACITANCES OVER 10 UUF	CAPACITANCES 10 UUF OR LESS	
BLACK	0	0	0	1		± 2.0 UUF	CC
BROWN	-30	1	1	10	± 1%		
RED	-80	2	2	100	± 2%	± 0.25 UUF	
ORANGE	-150	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-330	5	5		± 5%	± 0.5 UUF	
BLUE	-470	6	6				
PURPLE (VIO. ET)	-750	7	7				
GRAY		8	8	0.01*			
WH		9	9	0.1*	± 10%		
GOLD	+100			0.1		± 1.0 UUF	
SILVER				0.01			

1 THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF

2 LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS MIL-C-5, MIL-C-25D, MIL-C-11272B, AND MIL-C-10950C RESPECTIVELY

3 LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D

4 TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE

* OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

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